

## CLAIMS

What is claimed is:

1. A method of transferring variable-length data frames across a  
5 synchronous network employing a multiple-channel synchronous  
transport signal to carry data among nodes of the network,  
wherein each channel of the synchronous transport signal carries  
data in fixed-size payloads, comprising:

10 encapsulating each data frame in a corresponding point-to-  
point frame, each point-to-point frame including a body portion  
of the corresponding data frame and a length value, the length  
value being located at a predetermined position in a beginning  
portion of the point-to-point frame;

15 dividing each point-to-point frame into a corresponding set  
of fixed-sized segments, a first one of the segments of each set  
carrying the beginning portion of the corresponding  
point-to-point frame such that the length value is located at a  
predetermined position in the first segment;

20 transmitting the segments of each point-to-point frame as a  
corresponding set of payloads of at least one channel of the  
synchronous transport signal, each set of payloads being marked  
so as to be identifiable in a stream of payloads of the at least  
one channel of the synchronous transport signal;

25 receiving each set of payloads of the at least one channel  
of the synchronous transport signal, and from each received set  
of payloads regenerating the corresponding point-to-point frame  
based at least in part on the length value from the first  
segment; and

30 de-capsulating each regenerated point-to-point frame to  
recover the corresponding data frame.

2. A method according to claim 1, wherein the segments of the  
point-to-point frames are transmitted as corresponding sets of

payloads of at least two channels of the synchronous transport signal, but the segments of each point-to-point frame are carried in payloads of only a single one of the at least two channels.

5 3. A method according to claim 2, wherein each point-to-point frame also includes a sequence number identifying its temporal position among the point-to-point frames carrying the data frames, and further comprising re-ordering the point-to-point frames regenerated from the received sets of payloads based on  
10 the respective sequence numbers so as to recover the data frames according to an original ordering.

15 4. A method according to claim 2, further comprising selecting which of the at least two channels of the synchronous transport signal is to carry each point-to-point frame based on channel load balancing criteria.

20 5. A method according to claim 4, wherein each channel has associated therewith a corresponding buffer for temporarily storing point-to-point frames to be transmitted via the channels of the synchronous transport signal, and wherein the load balancing criteria includes maintaining no more than a predetermined difference in the fullness of the buffers.

25 6. A method according to claim 1, wherein the payloads of each channel of the synchronous transport signal are arranged into multi-payload superframes, each superframe including overhead information common to all payloads of the superframe.

30 7. A method according to claim 6, wherein a superframe is permitted to include a payload containing the end of one point-to-point frame and a payload containing the beginning of another point-to-point frame.

8. A method according to claim 1, wherein each set of payloads includes a payload marked as an end of frame payload, and wherein regenerating the point-to-point frame from a set of payloads includes determining, using the length value, a precise location within the segment carried by the end of frame payload at which the point-to-point frame ends.

9. A method according to claim 1, wherein the at least one channel is one channel in a first of multiple bundles of channels, the bundles being associated with different sets of users of the synchronous network.

10. A method according to claim 9, wherein the payloads in the channels of all the bundles are the same size.

11. A method according to claim 9, wherein each bundle is associated with a corresponding specific user within the set of users associated with the bundle, and wherein each point-to-point frame transmitted by a user is transmitted on the associated bundle and multicast to all other users of the associated set of users.

12. A method according to claim 11, wherein each point-to-point frame transmitted via the bundles of channels is dropped and continued within the synchronous network based on the identity of bundle.

13. A method according to claim 9, wherein the use of the bundle of channels is shared by all users in the set of users associated with the bundle.

14. A method according to claim 13, wherein the transmission of point-to-point frames on an associated bundle of channels is controlled by a scheduling process that allocates the use of each

bundle among the associated set of users according to a predetermined bandwidth allocation scheme.

15. A method according to claim 14, wherein each point-to-point frame transmitted via the bundles of channels is dropped and re-transmitted within the synchronous network based on information within the point-to-point frame identifying a destination of the point-to-point frame within the network.

16. A method according to claim 15, wherein the destination information is destination information appearing in the data frame encapsulated within the point-to-point frame.

17. A method according to claim 15, wherein the destination information included in each point-to-point frame is generated from separate destination information included in the data frame encapsulated by the point-to-point frame.

18. A network device for transferring variable-length data frames across a synchronous network employing a multiple-channel synchronous transport signal to carry data among nodes of the network, wherein each channel of the synchronous transport signal carries data in fixed-size payloads, comprising:

encapsulation logic operative to encapsulate each data frame in a corresponding point-to-point frame, each point-to-point frame including a body portion of the corresponding data frame and a length value, the length value being located at a predetermined position in a beginning portion of the point-to-point frame;

segmentation logic operative to divide each point-to-point frame into a corresponding set of fixed-sized segments, a first one of the segments of each set carrying the beginning portion of the corresponding point-to-point frame such that the length value is located at a predetermined position in the first segment;

transmitting circuitry operative to transmit the segments of each point-to-point frame as a corresponding set of payloads of at least one channel of the synchronous transport signal, each set of payloads being marked so as to be identifiable in a stream of payloads of the at least one channel of the synchronous transport signal;

receiving circuitry operative to (i) receive sets of payloads of at least another channel of the synchronous transport signal, and (ii) from each received set of payloads, regenerate a corresponding point-to-point frame based at least in part on a length value from a first segment thereof; and

de-capsulation logic operative to de-capsulate each regenerated point-to-point frame to recover the corresponding data frame.

19. A network device according to claim 18, wherein the encapsulation logic is further operative to include a sequence number with each point-to-point frame, the sequence number identifying the temporal position of the point-to-point frame among the point-to-point frames carrying the data frames, and further comprising re-sequencing logic operative to re-order the point-to-point frames regenerated from the received sets of payloads based on the respective sequence numbers so as to recover the data frames according to an original ordering.

20. A network device according to claim 18, further comprising selection logic operative to select which of the at least two channels of the synchronous transport signal is to carry each point-to-point frame based on channel load balancing criteria.

21. A network device according to claim 20, further comprising buffers associated with respective ones of the channels for temporarily storing point-to-point frames to be transmitted via the associated channels, each buffer providing information

regarding its relative fullness, and wherein the load balancing criteria used by the selection logic includes maintaining no more than a predetermined difference in the fullness of the buffers.

22. A network device according to claim 18, wherein the payloads of each channel of the synchronous transport signal are arranged into multi-payload superframes, each superframe including overhead information common to all payloads of the superframe.

23. A network device according to claim 22, wherein a superframe is permitted to include a payload containing the end of one point-to-point frame and a separate payload containing the beginning of another point-to-point frame.

24. A network device according to claim 18, wherein each set of payloads includes a payload marked as an end of frame payload, and wherein the receiving circuitry is further operative to determine, using the length value of each received point-to-point frame, a precise location within the segment carried by the end of frame payload at which the point-to-point frame ends.

25. A network device according to claim 18, wherein the at least one channel is one channel in a first of multiple bundles of channels, the bundles being associated with different sets of users of the synchronous network.

26. A network device according to claim 25, wherein the payloads in the channels of all the bundles are the same size.

27. A network device according to claim 25, wherein each bundle is associated with a corresponding specific user within the set of users associated with the bundle, and wherein each point-to-point frame transmitted by a user is transmitted on the associated bundle and multicast to all other users of the

associated set of users.

28. A network device according to claim 27, wherein each point-to-point frame transmitted via the bundles of channels is dropped and forwarded within the synchronous network based on the identity of bundle.

29. A network device according to claim 25, wherein the use of the bundle of channels is shared by all users in the set of users associated with the bundle.

30. A network device according to claim 29, wherein the transmission of point-to-point frames on an associated bundle of channels is controlled by a scheduling process that allocates the use of each bundle among the associated set of users according to a predetermined bandwidth allocation scheme.

31. A network device according to claim 30, wherein each point-to-point frame transmitted via the bundles of channels is dropped and forwarded within the synchronous network based on information within the point-to-point frame identifying a destination of the point-to-point frame within the network.

32. A network device according to claim 31, wherein the destination information is destination information appearing in the data frame encapsulated within the point-to-point frame.

33. A network device according to claim 31, wherein the destination information included in each point-to-point frame is generated from separate destination information included in the data frame encapsulated by the point-to-point frame.